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LOBLOLLY PINE

A Woodland Crop

BY

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T. B. SYMONS, Director.

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FOREWORD

Loblolly pine approaches the ideal as a forest tree in the Coastal Plain region of Maryland. Its rapid growth, together with a ready market for pine products, makes it a favorite on cut-over and abandoned farm lands; and the increased interest among farmers where its value has been demonstrated by the State Department of Forestry and Extension Service, bids fair to secure for it its proper place in progressive farm management.

Favorable growing seasons, level to gently rolling lands, and splendid markets for farm produce, especially truck crops, give rise, in many parts of this region, to an intenstive agriculture. In the marketing of truck products, large quantities of wooden containers are indispensable, and an accessible supply of timber for the production of these containers is a pronounced benefit to the truck farmer. Not only does loblolly pine serve these needs in a most satisfactory way, but it is in demand for mine props, piling, saw timber and numerous miscellaneous uses.

This bulletin is part of a larger bulletin prepared several years ago by Joshua A. Cope, Assistant Forester of the State Department of Forestry. Through the cooperation of the State Department of Forestry, this information on the management of loblolly pine becomes available as an Extension Service Bulletin. Throughout its preparation there has been constantly kept in mind the practical questions which owners of mature pine woodlands, as well as land owners interested in the propagation of this pine, are asking. The growing recognition among farmers that loblolly pine is essentially an agricultural crop, responding most favorably to proper treatment, is responsible for the demand for information concerning the loblolly pine.

T. B. SYMONS,
Director

UNIVERSITY OF MARYLAND
Extension Service

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Loblolly Pine—A Woodland Crop

By JOSHUA A. COPE, Assistant Forester

It is the purpose of this bulletin to take up for consideration the various steps in the production of a crop of loblolly pine—its establishment, its care while growing, and the final harvesting of the mature timber. These steps, it will be noted, provide an exact parallel to the handling of agricultural crops, in fact, it is only the time element that differentiates forest from agricultural crops.

The thousands of acres of cut-over land throughout the lower counties of the Eastern Shore now growing a crop of briars, weeds, and inferior hardwoods, where a few years ago were splendid stands of pine, give eloquent testimony that the present methods of cutting do not bring back a crop of pine. Nor is there any let up in the demands for pine timber for consumption both within and outside the region; a demand so keen that immature stands are often sacrificed, and the Peninsula over, annual cutting marches far in advance of annual growth.

Obviously to avoid practical depletion of existing supplies within the next decade, either cutting must be curtailed or provision made whereby annual growth will at least equal the annual cut. Without prohibitive legislation running counter to the laws of supply and demand, it would be impossible to stop cuttings.

On the other hand the suitability of the soil for the production of wood is such, that existing forest areas on the Peninsula can more than meet all the present demands for various forest products, provided each acre is working to its normal capacity in growing wood. The practice of forestry, as applied to the Eastern Shore, has for its objective the bringing about of such well-stocked acres. Since loblolly pine is the fastest growing commercial species native to the region, these acres, on the uplands at least, should grow this species exclusively.

ESTABLISHING THE YOUNG STAND NATURALLY.

The very finest second growth stands of loblolly pine on the Peninsula today came up on abandoned fields, from seed supplied by adjacent trees. These are natural stands which became established without cost or planning to the original owner, simply because there was a fortunate combination of good seed and good seed-bed conditions.

There are now no vast areas of abandoned farm land, such as abounded in the period following the Civil War, to provide such seed bed conditions. By planning, and a small outlay of time and money, however, these conditions can be approximated and natural stands established on areas now bearing a mature crop of pine or pine and hardwood in mixture, ready to be cut.

THE SEED SUPPLY.

The first step in the planting is to secure an abundant supply of seed. It has been pointed out that heavy seed years occur in the crowded growing conditions of the average stand of loblolly pine at three- to four-year intervals. If a stand were cut, therefore, in the late winter following a seed year, there is a reasonable assurance, provided seed-bed conditions are at all favorable, of securing a good stand of young pine seedlings the following spring. It is not, however, always convenient to cut a stand immediately following a seed year. The seed-bed conditions may not be favorable even if cut at such time, and finally a fire might easily wipe out the young seedlings and there would then be available no trees to furnish another supply of seed. In view of these conditions, it has been found expedient to leave a few of the mature trees at the time of cutting to supply seed for the cut-over area. Cutting, following a seed year, is to be encouraged, but the leaving of seed trees in such instances is in the nature of insurance, providing the means for another crop of seedlings in case of fire.

PLATE 1—NATURAL SEEDING ON ABANDONED FIELD.
Two seed trees have brought about a dense young stand on a half acre.

The objection has been raised that these "scattered seed trees," as they are generally called, will be subject to windthrow, and, therefore, defeat the object for which they were left. The strong, deep root system of the loblolly pine makes it particularly wind resistant, and on experimental areas in Worcester and Somerset Counties, where such seed trees have been isolated for four years, not a single one has been uprooted.

NUMBER AND CHARACTER OF SEED TREES.

It is most essential that the supply of seed for the area on which the young stand is to be established should be abundant. Such experiments, as have been carried on, indicate that a loblolly pine tree will distribute seed abundantly, over an area around the base about equal to its height. If 70 feet is assumed as the average height of trees in a mature stand, a spacing of 140x140 feet should give satisfactory results. To be on the safe side, however, a spacing of 100x100 feet is advisable, or approximately 4 seed trees to the acre.

In picking out the trees to leave for seed, it is not necessary to select the very largest and most valuable trees in the stand. On the other hand, if small crowned, overtopped trees are left, they would be so long in recovering from their suppression and in gaining enough strength to produce seed as to be valueless for the purpose. Average sized trees in the stand with good healthy crowns will supply sufficient seed. If they are crooked or forked, which lessens their merchantable value, so much the better, as these defects do not lessen seed production, and such trees represent a smaller investment for the owner to carry until the young crop is established and has passed the normal fire danger period (10 years), when, if desired, the seed trees can be harvested.

PLATE 2—SEED TREE ON EXPERIMENTAL AREA IN WORCESTER COUNTY LEFT AFTER LOGGING.

The seed trees should be conspicuously marked, preferably with white paint, both at the stump and at the eye level, so there need be no excuse on the part of the cutters in felling such trees by mistake.

In an 800 acre tract where the seed trees at the rate of four to the acre were recently marked, a proper distribution of seed trees was achieved by running a compass line through the center of an acre wide strip (208 feet) with a man following on each side of the compass line and at a distance of 50 feet from it. At every 100 foot interval, seed trees were selected and marked with white paint. When the end of the timber was reached, a right angled offset of 208 feet placed the crew in the center of the next acre-wide strip for the return trip. In this particular job the work was considerably retarded by dense undergrowth and greenbriar and the cost per acre of selecting and marking seed trees was 27 cents.

PLATE 3—LOBLOLLY PINE SEEDLINGS THREE MONTHS OLD.

Germination conditions around stumps are most favorable, and with plenty of sunlight after lumbering, they will grow rapidly.

Preparing Seed Bed Conditions.

After making provisions for an abundant seed supply the second and equally important step in establishing the new crop is the securing of suitable seed-bed conditions. It has been shown that loblolly pine seed prefers an exposed mineral soil for germination.

Where the pine needles are used for bedding, the forest floor is kept constantly clear and a good seed bed is thus already provided. However, under the forest conditions generally prevalent throughout the region, a heavy layer of needles and decayed matter covers the floor to the depth of several inches and prevents germination.

There is on record a dense six-year-old thicket of pine in Talbot County growing on what was originally a strawberry bed, far removed from any pine trees of seed bearing age. Lacking straw to cover his strawberry plants, the owner had gone into the woods in the late fall and raked up a cartload of pine needles. The next spring the pine seed which has been raked up along with the needles came in contact with the mineral soil of the strawberry bed and germination was prompt and abundant. In the dense, relatively dry layers of needles on the forest floor those same seeds would never have germinated, and even if an especially wet spring had furnished enough moisture to induce germination, the rootlets would not have been able to reach down to the life sustaining soil.

Use of Fire.

The most economical way of removing the forest litter is by carefully controlled burning. The ideal time to do such burning is the late summer—August-September. The ground surface then is usually dry, so that clean burning may result, while there is sufficient green vegetation to contol the fire easily. Burning can be done either before or after logging. If done before, especially where undergrowth and green briar are prevalent, the logging will be facilitated and the light surface fire will not appreciably damage the seed trees or blacken the butts of the trunks sufficiently to increase logging costs. If done after logging, the tops and lops will also be consumed and thus the subsequent fire risk lessened.

On an experimental area in Worcester County the burning was done after logging with very satisfactory results. The only precaution required was the removal of brush around seed trees. The cost of burning was $1.50 per acre. On larger areas, this would be greatly reduced.

Disturbing the Surface of the Ground.

When it is felt that the risk to adjoining timber from burning is too great, some other method will have to be employed for removing the forest litter and exposing the mineral soil. Reference has already been made to the removal of needles for bedding purposes. The mere act of logging will disturb the surface to some extent, but not uniformly enough over the area to insure an evenly distributed crop of young pines. In a pure stand of pine a new ground plough run through the woods prior to logging, so as to expose the mineral soil generally over the tract, would probably be effective. In a mixed stand the surface roots of the hardwoods would make such preliminary work impossible.

RELEASING THE PINE SEEDLINGS.

The prevailing practice of the region has been to sell timber to an 8 or 10 inch stump diameter limit, and this practice has worked to the prevention of the establishing of another crop of pine, and brought real truth to the saying familiar throughout the Peninsula—hardwoods follow pine. The reason is not far to see. The 8 or 10 inch diameter limit, while theoretically applying to all timber, in practice was carried out only in reference to pine and perhaps white oak. This meant that even such pines as did get established from seed distributed prior to logging, by workingtheir way through the duff, had no chance to develop under the dense shade of the inferior hardwoods, such as black gum, maple, dogwood, etc., left after logging.

The pines left below the diameter limit were spindly and small crowned, and consequently were not able to produce seed for many years. In the meantime the whole tract became a dense mass of hardwood growth, with inferior species usually predominating. Ride in any direction in any county of the lower Eastern Shore, and hundreds upon hundreds of acres will reveal such conditions.

PLATE 4—A VALUABLE AID IN PREPARING FOR ANOTHER CROP OF LOBLOLLY PINE.

This cutting and splitting machine turns out a cord per hour.

Manifestly then, it is not enough to leave seed trees, and prepare seed-bed conditions, if we are to have a complete stand of pine. Provision must be made for the removal of the hardwoods at the same time, or immediately after the pine is cut. The recent increase in the demand for fuelwood offers an opportunity for the bringing about of this highly necessary work.

By way of illustration, records are available to show that as far back as 1920 an operator went into a piece of woodland, after pine and valuable hardwoods to an 8 inch stump diameter had been removed, and utilizing material down to 1 inch in diameter, cut 12 cords to the acre. By the aid of a sawing and splitting machine (see Plate No. 4), this material was converted into stove length wood and sold at the mill at a net profit of $3.00 per cord or $36.00 per acre, even though this particular tract was six miles from town. It only remained to burn the piled brush at a cost of 50 cents per acre and the seed-bed conditions were then ideal for the start of another crop.

PLATE 5—LOBLOLLY PINE SEEDLINGS AND HARDWOOD SPROUTS, BOTH TWO YEARS OLD.

The Loblolly Pine is holding its own.

This sawing and splitting machine clearly proved its effectiveness and practicability for the work in hand. As owners come to see the necessity of removing the hardwoods there will be an increasing demand for such an outfit. It is believed that the day is not far distant when an owner will engage the services of an operator with such a machine to follow the sawmill man in his pine woods, just as he engages a threshing machine after the wheat is harvested.

In order, therefore, to establish a crop of pine to follow pine, or pine and hardwoods in mixture, the following steps seem necessary:

1—LEAVE SEED TREES—AT LEAST FOUR TO THE ACRE.

2—EXPOSE MINERAL SOIL THROUGHOUT THE AREA.
  (a) By raking "shats."
  (b) By new ground plough or other device for disturbing surface.
  (c) By carefully controlled burning.

3—CUT ALL EXISTING TREES ON AREA EXCEPT SEED TREES, INCLUDING SMALL PINE AND UNDERSTORY OF HARDWOODS.

The only condition where these three steps will not bring direct results in the way of establishing a complete stand of pine occurs when two or three years elapse between cutting operations and a seed year. The inevitable sprout hardwoods start immediately after cutting operations, and if the pine seedlings get a start the same year they will hold their own through the first critical years, and be ahead and crowding the hardwoods out in 15 years. This is well shown in Plate No. 5, taken on an experimental area in Worcester County, both the sprouts and seedlings being two years old.

Where an abundant supply of seed is not distributed from the seed trees until the second or third year after logging, even though seed-bed conditions are still favorable for germination so that the seedlings readily become established, growth will be checked by the overtopping hardwood sprouts.

HOLDING BACK THE SPROUT HARDWOOD GROWTH.

Supplementary to the three above described steps, it, therefore, becomes necessary to consider the menace of sprout hardwood growth, pending the final establishing of a complete stand.

It has been suggested that grazing, preferably by goats, would be effective in keeping down the hardwoods, and on a small scale this has been successfully demonstrated in Worcester County, as shown in Plates Nos. 6 and 7. A fence confined the goats to the area shown in Plate No. 6 and as a result the pine is well established, while in the other area where the goats did not have access the hardwoods have successfully crowded out the pine. The only objections to this effective method of hardwood supression is to be found in the initial cost of fencing. It is to be hoped that woodland owners will be willing to try out demonstrations along this line on a much larger scale in the near future.

The other alternative is by the method of cleaning which is fully described on page 18.

ESTABLISHING THE YOUNG STAND ARTIFICIALLY.

When it is desired to start a stand of loblolly pine on an abandoned field, or on cut-over land where no seed trees are available, it becomes necessary to sow seed or plant out small trees.

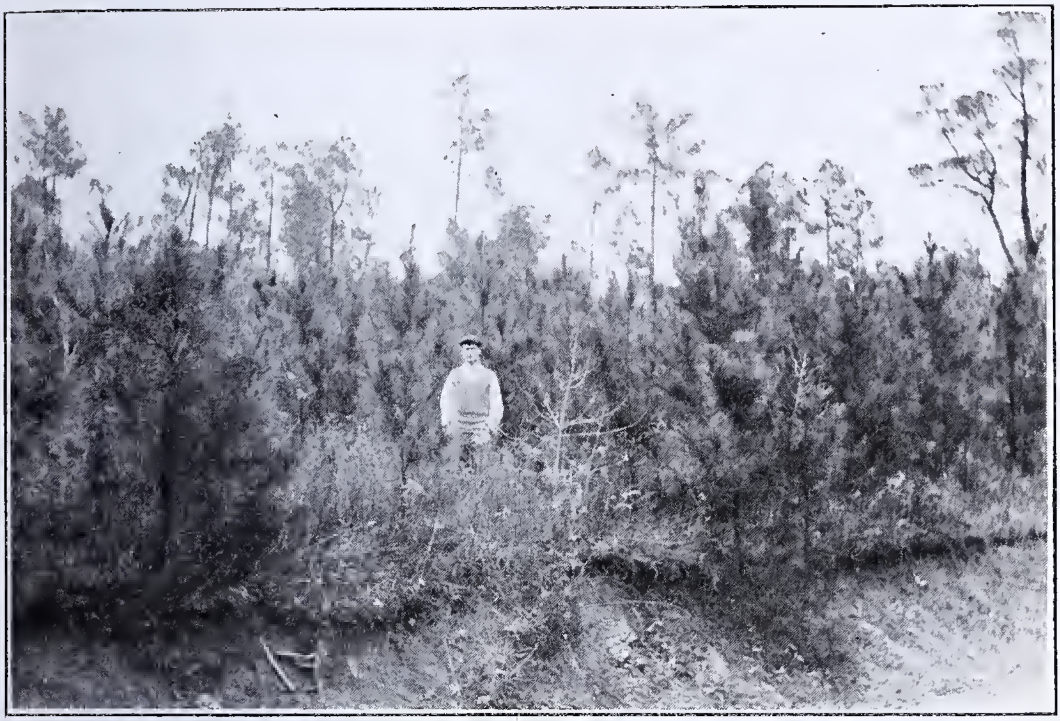

PLATE 6—GOATS IN THIS AREA KEPT THE HARDWOODS DOWN.

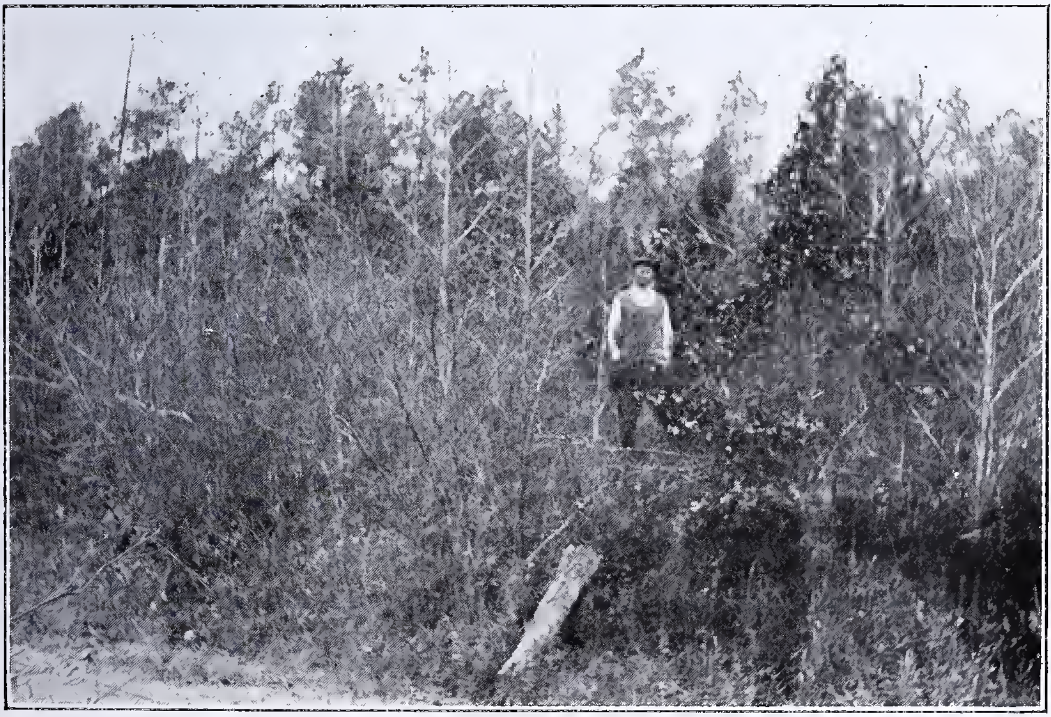

PLATE 7—GOATS EXCLUDED FROM THIS AREA WITH A CONSEQUENT PREDOMINANCE OF HARDWODDS.

SEEDING.

Since it is not always possible to purchase dependable loblolly pine seed, it is advisable for the owner contemplating seeding to collect the cones himself from low branching open grown trees along ditch banks, or by following the cutters at logging operations.

PLATE 8—COLLECTING LOBLOLLY PINE CONES.

The seed after extracting is planted at the State Forest Nursery to produuce planting stock for reforestation.

The cones are fully ripe by the middle of October, but do not open up to permit the escape of seed until well toward the middle of November, so that there is a four-week period when the collection can be carried on. During the heavy seed year of 1921, prices paid by the State Department of Forestry ranged from 75 cents to $1.00 per bushel depending on whether the cones were taken from felled or standing trees.

The cones must then be spread out in the sun in a single layer on large sheets, for three or four days, or else placed on trays and subjected to a temperature of around 120 degrees F. for 72 hours. The cones will then open up and the winged seeds can readily be shaken out. For convenience in handling it is best to break off the wings by rubbing the seed through a sieve.

Figuring a pound of seed to a bushel of cones, the seed should not cost in time and labor more than $1.50 a pound, in cases where the owner has the work done under his own direction.

The seed stored in a bag in a cool dry place will keep sound until the following spring. Nature's way, however, is to distribute the seed in the fall and it is believed advisable to follow nature's method.

The preparation of the ground would be the same whether seeding was to be natural or artificial and this matter has already been taken up. (See page 6.)

Experiments in broadcast seeding have not progressed sufficiently in Maryland to give an index to the amount of seed required to insure a good stand under average conditions. From experiments in other states, however, it is believed that three pounds to the acre would be ample. The seed would be broadcasted by hand, sowing in two directions in order to insure a more even distribution. Figuring the cost of seed at $1.50 a pound and the cost of seeding at 50 cents per acre, the cost of establishing a crop of pine is thus $5.00 an acre, exclusive of any cost in site preparation.

It is also possible to drill the seed in rows six feet apart, and then thin out the rows after the seedlings become well developed. This reduces the amount of seed needed per acre by 50 per cent. No experiments of this nature have as yet been tried in Maryland.

The risk of seed being destroyed by rodents, and the possibility of weather conditions unfavorable to germination, are factors, however, that work against the use of these methods in securing a new stand. On the relatively small areas that will be replanted at any one time by an owner, it is believed that more satisfactory results will be obtained by planting.

PLANTING.

Fortunately for the interested land owner, loblolly pine plantations have already been established in various sections of the Eastern and Western Shore of the Coastal Plain, and from the records of these plantations, the following recommendations are deduced.

Use of Wild Stock.

One of the most successful loblolly pine plantations in the State is in upper Dorchester County near Galestown. On this plantation lifted wild stock, gathered on the edge of the woods, was used. The best results with such stock were obtained when the planting was done in the spring as soon as the frost was out of the ground and when plants between 10 inches and 15 inches in height were used, or what amounts to two-year-old seedlings.

A spacing of 6 feet by 6 feet, or 1,210 trees to the acre gives good results. It will be noted on Plate No. 9 that at the end of the seventh year the side branches are touching and a forest floor is being formed.

When the stock suitable for this work can be found on the farmer's own land, or will be given by neighbors, the only cost proper to charge against the stock is that of lifting.

In the light sandy soils general throughout these counties, such small seedlings can readily be pulled up without great damage to the root system; such as are damaged in the pulling can be discarded.

PLATE 9—SEVEN-YEAR-OLD PLANTATION OF LOBLOLLY PINE ON REIMER FARM (See text, page 17).

It is necessary to keep the roots carefully covered to prevent drying out while transporting to the planting site. The planting is, perhaps, most quickly done by making a V shaped opening with a spade, inserting the roots, and packing the earth firmly around with the foot.

Planting costs, minus supervision, on an acre basis on the plantation in upper Dorchester County were as follows:

Lifting wild stock (1,200 seedlings)	$ .75
Hauling charges	.25
Planting	2.50
Total	$3.50

Nursery Grown Stock.

Where quantities of wild stock of the right size are not readily available (this often happens due to infrequency of seed years) or where a cash outlay is required for the purchase of such stock, it will be found advisable to use nursery grown stock. In fact, many owners will prefer such stock because of its uniform size and well developed root system. Certainly where any extensive plantations are contemplated running up into tens of thousands of seedlings, nursery stock will have to be depended on.

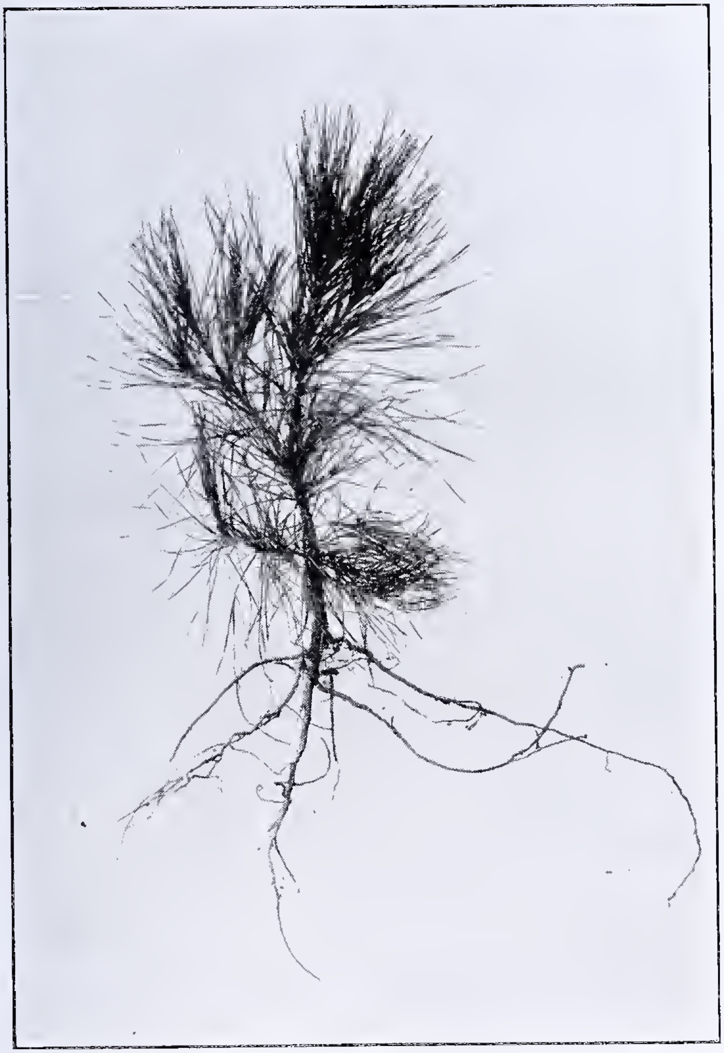

PLATE 10—TWO-YEAR-OLD LOBLOLLY PINE SEEDLING.
Scale: One inch equals 8 inches.

To meet this need, which is felt to be an increasing one, there are available at the State Forest Nursery thrifty loblolly pine seedlings at an exceedingly low cost.

It will be noted that planting shows only a slight increase in cost over seeding. The two year start obtained in the case of planting offsets this extra cost, and it is believed that most owners will desire to avail themselves of planted stock.

Several planting demonstrations were started in the spring of 1923, using one year old seedlings. These seedlings had developed splendid height growth during the year (10 inches to 12 inches, see figure 2); but the root system is not as well developed as on the two year seedlings. If these plantings are as successful as present conditions indicate, it will point to the use of one year seedlings on sites where the competition from hardwood sprouts and undergrowth is at a minimum. All costs would be practically the same with the exception of the price of the stock, $1.50 instead of $2.00 per thousand.

It will be noted that in the above tabulation of costs no allowance has been made for the preparation of the site. In the case of establishing a forest on an abandoned field the preparation of the site costs nothing. In the case of replanting on cut over lands, this cost can properly be laid against the cutting operation. Mention has already been made of the operator (see page 9) who went in after logging was through and cleared off the area at a considerable profit.

REMOVAL OF ADVANCED HARDWOOD GROWTH.

In the case of an area covered with hardwood sprout growth it is a matter of location and market conditions, as well as size of trees, that will determine just when a cordwood cutting will pay for itself and the preparation of the site as well. On an experimental area established in Worcester County in the spring of 1923, 3 acres of sprout hardwood growth, 6 years old, averaging 15 feet in height, and 3 to 4 inches in diameter, and amounting to 4-2/3 cords per acre, were cut off and sold as fuel in a town 4 miles away, at a gross return of $27.42 per acre. This was offset by cutting, sawing and hauling costs amounting to $28.27 per acre, or a net loss of 85 cents per acre in removing the wood. The cost of site preparation (burning the brush), amounted to $4.67 per acre. This is excessively high and can only be accounted for by an abnormally wet spring and the inexperience of the men in burning. The planting costs were $2.20 per acre and the one year seedling stock, plus freight, was $1.60 per acre, so that it cost $9.32 per acre to establish this stand. It is estimated that a ten year old growth will yield sufficient wood to offset all costs of site preparation, provided the burning can be kept to a reasonable cost of $1.00 per acre.

Records of plantations already established will be of interest in showing results accomplished.

Reimer Plantation.

Measurements on this plantation near Galestown, Dorchester County, 7 years after planting:

Number, Height and Diameter of Trees on one Acre.

D. B. H. Inches	Height in Feet		
	5-10 Feet	10-15 Feet	15-20 Feet
	Number of Trees		
1	80	---	--
2	60	200	40
3	--	200	170
4	--	40	260
5	--	--	40
Totals	140	440	510

It will be seen from the above that many of the trees are growing at the rate of 2½ feet a year in height and ½ inch in diameter.

Bowie Plantations.

At a plantation made near Bowie, Prince George County, considerably outside of the natural range of loblolly pine, the growth has been equally good. Trees set out in 1910 had an average height of 30 feet in 1920 and trees set out in 1915 had an average height of 15 feet at the end of 5 years.

Jesterville (Wicomico County).

This is the oldest forest plantation so far as is known in the State, having been made in the year 1877, and though only a little over an acre in area it presents results that are most encouraging.

A record taken in 1922, or when the stand was 45 years old, showed the following results on an acre basis—only live trees recorded:

Diameter Breast-high Inches	Dominant	Intermediate
	Number of Trees	
9	--	12
10	--	20
11	28	--
12	60	--
13	56	--
14	44	--
15	16	--
Totals	204	32

The dominant trees averaged well over 80 feet in height and the intermediate 70 feet in height.

Working these measurements up in terms of board feet by means of volume table (see appendix) and substituting such results, the table becomes:

Diameter Breast-high Inches	Dominant	Intermediate
	Board Feet	
9	-----	540
10	-----	1,400
11	3,080	-----
12	8,400	-----
13	9,520	-----
14	8,800	-----
15	3,760	-----
Totals	33,560	1,940

This shows an actual yield of 35,500 board feet of timber per acre which is even higher than yields given for natural stands at this age on site quality 1. At a stumpage value of $8.00 per thousand board feet, this stand would be worth $284.00 per acre for lumber. It so happens in the particular section where this stand is located, that cordwood commands a higher price than lumber as the near-by fishing villages are quite dependent on local wood for fuel.

According to figures available in that section pine cordwood had a stumpage value of $5.00 per cord, in 1923. Converting this stand into cordwood rather than lumber, it contains 65 cords of wood per acre, or stumpage value of $325.00 per acre at the end of the 45th year.

ATTENTION WHILE GROWING.

CLEANINGS.

On account of the ability of fresh cut hardwood stumps to sprout as well as on account of the shade-enduring characteristics of hardwood seedlings, it is usual for hardwoods to take possession of the land after logging, even if the original land was 75% pine. Where provision is made for another crop of pine by leaving seed trees and by exposing the mineral soil, hardwood sprouts will offer serious competition unless pine seedlings become established the year following logging, and have an even start with the sprouts. Where the hardwoods have such an advantage that the pine, with its greater demand for light, will be retarded if not wholly suppressed, a cutting is needed to release the young pine and such a cutting is termed a "Cleaning."

Cleanings should be made as soon as it is evident that the inferior species is checking the growth of the young pine, certainly by the 4th or 5th year, in the life of the pine.

In making such cleanings it is not necessary to cut the hardwoods back to the ground. All that is required is to slash back the tops, so as to release the tops of the young pine to full sunlight. In doing this work a corn knife has been found very effective and the cost can readily be kept under $1.00 per acre.

In rare instances a second cleaning may be necessary after 3 or 4 more years, but usually one is sufficient to give the pine the advantage.

While cleanings represent money expended, for which there is no immediate return, it is necessary work wherever the young loblolly pines are being smothered by overtopping vigorous growing hardwoods.

PLATE 11—A LOAD OF PINE "SHATS."

THE REMOVAL OF NEEDLES FROM THE FOREST FLOOR.

It is a very common practice throughout the Eastern Shore, especially in the southernmost counties where little wheat is grown, to take the needles from the forest floor for bedding purposes. In such localities the annual crop of needles is a valuable product of the forest, so important to the farmer that, in the strawberry and sweet potato sections, if he did not have pine woods of his own, or was unable to secure pine needles from accommodating neighbors, he could scarcely carry on his trucking operations in competition with those possessing an abundant supply. In other words, for the needles alone in these trucking sections, a pine thicket is almost essential to the success of a farm.

In order to ascertain what thickets will yield in the way of an annual crop of needles, a fractional acre plot was laid out several years ago in Somerset County. Every other year the needles from this plot are carefully raked up and measured by the dump-cart load. The measurements show that in a well-stocked young stand of pine the annual fall of needles amounts to three one-horse cart loads per acre.

Pine needles do not, in effect, have a sale value due to the fact that every farmer has, or can obtain without cost from his neighbors, sufficient needles for his own needs. It is safe, however, to assume that their value to the land is easily 25 cents per cart load as they lie in the woods, or an annual value to the trucking farmer of 75 cents per acre.

Some owners have felt that the removal of "shats," or needles, was a direct benefit to the forest and accordingly have given widespread permission for neighbors to come in their thickets and take out all they wanted. As a matter of fact, the removal of "shats" has a direct bearing on the growth rate of the timber.

The thick layer of needles on the forest floor, in the natural state, provides a sure preventative for evaporation of soil moisture. In disintegrating, the needles add food to the soil which the growing pine stand absorbs, as do the truck crops.

MEASURING NEEDLES AGAINST LUMBER.

It is a rather difficult matter to arrive at an exact measure of the effect of "shat" removal on the growth of pine, but fortunately for the purpose, a 55 year old stand of pine was found in Worcester County divided into two parts by a county road. This stand, like many others in the locality, had come up after the Civil War on an abandoned field. The owner had needed only a portion of the needles to carry on his trucking and so he had allowed the county road to act as a dividing line. On one side he raked "shats" each year; on the other side the stand was allowed to remain intact, just as nature intended it. All other conditions were relatively the same, age of stand, quality of soil, and number of trees per acre. In 1920 a ¼ acre sample plot was measured in average conditions, on each side of the county road, with the following significant results:

TABLE 1—Effect of regular removal of Loblolly Pine needles over a period of years. Figures on an acre basis. Stand 55 years old.

CHARACTER OF TREATMENT	NO. OF TREES	AV. DIAM. B. H. INCHES	AV. HGHT. DOMINANTS FEET.	TOTAL CU. FT.	TOTAL BD. FT.
Needles not removed	230	11.6	78	5,287	24,800
Needles removed	228	11.5	68	4,476	18,600

It will be noted that the average diameter growth on both plots is surprisingly close and the number of trees is almost the same. It is in the height growth that the difference occurs. In other words the constant removal of the needles has served to reduce the ability of the soil for producing a given quantity of lumber in a given number of years. The advantage in favor of leaving the "shats" is 6,200 board feet in 55 years. At prevailing stumpage prices per acre, this would be about $62.00. In other words, the "shats" have added over a dollar per acre a year, to the value of the stand. This amount is small compared with the fertilizing value of the needles to truck crops and the position is not here taken that needles should not be removed.

PLATE 12—LOBLOLLY PINE THICKET 15 YEARS OF AGE.
A thinning is being made to stimulate growth and produce a profit in fuel wood.

When a farmer needs his "shats" for better crops he should take them, but if he is so fortunate as to have more pine land than he needs, he should restrict the raking to certain definite portions and allow the rest of the woodlands to go untouched until harvest time. The removal of the "shats," prior to a logging, will facilitate preparations of site for the next crop of pine.

THINNINGS.

The term "thicket," which is in common use throughout the Eastern Shore, as applied to vigorous growing young stands of pine, is an apt expression. Frequently on abandoned fields, the saplings at 10 years of age are so close together as to render the stand almost impenetrable. 3,000 saplings to the acre at 10 years of age and

300 mature trees at 40 years of age summarize in a concise way the tremendous struggle that goes on constantly through these years. Nature unaided thus matures a crop of pine as the yield tables in Appendix so graphically show. By assisting nature in her work of thinning out this 90 per cent excess, growth on those trees that are to come through as the final crop to be harvested is stimulated. There is the further advantage to be derived from such thinnings in the fact that trees, otherwise falling down and rotting, can be utilized for such purposes as staves, fish pound poles or fuelwood, thus bringing some return prior to the final harvesting of the crop.

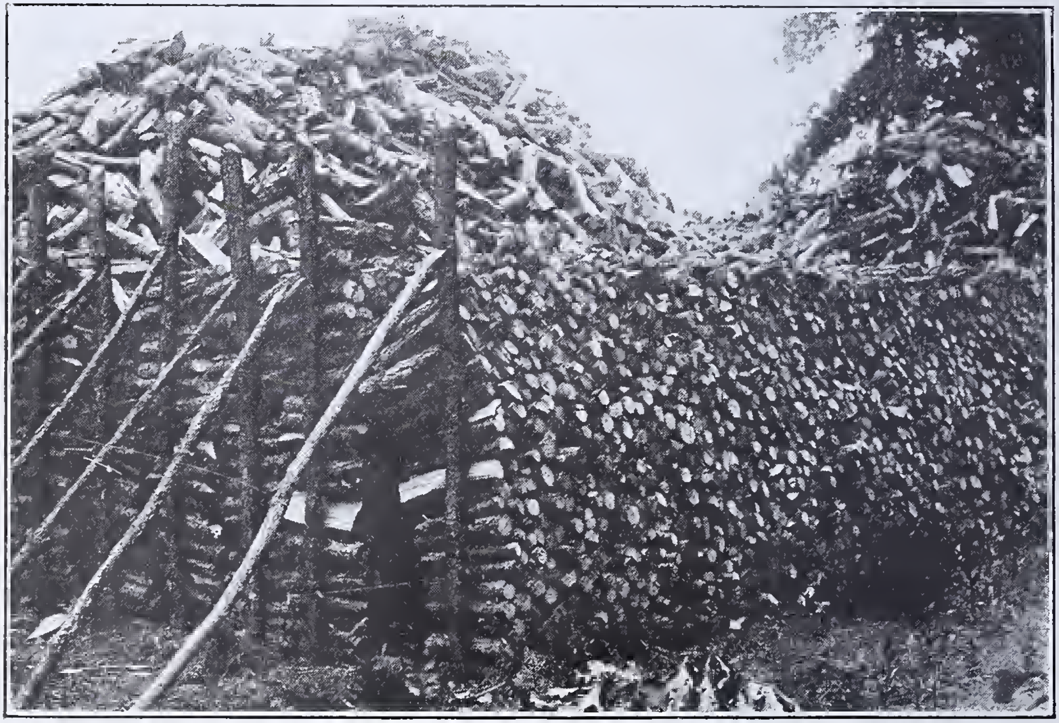

PLATE 13—STACKED WOOD FROM A THINNING IN A 15-YEAR-OLD STAND OF LOBLOLLY PINE.

The owner obtained $10.00 per acre profit.

Theoretically, light thinnings would be of value in improving growing conditions as early as the 10th year, but the material to come out at such age is so small that it has no commercial value. In view of the fact that loblolly pine can thin itself out naturally, it is not recommended that thinnings in young stands be undertaken until the material to be taken out has a sale value. The location of the stand and the demand for such products as fish pound poles and fuelwood will determine the proper time to make such thinnings.

In thickets adjacent to Chesapeake Bay and its tributaries, fish pound poles may be taken out as early as the 15th year. In fact, one farmer in lower Somerset County has paid his taxes for a number of years from just such thinnings in his loblolly pine thickets.

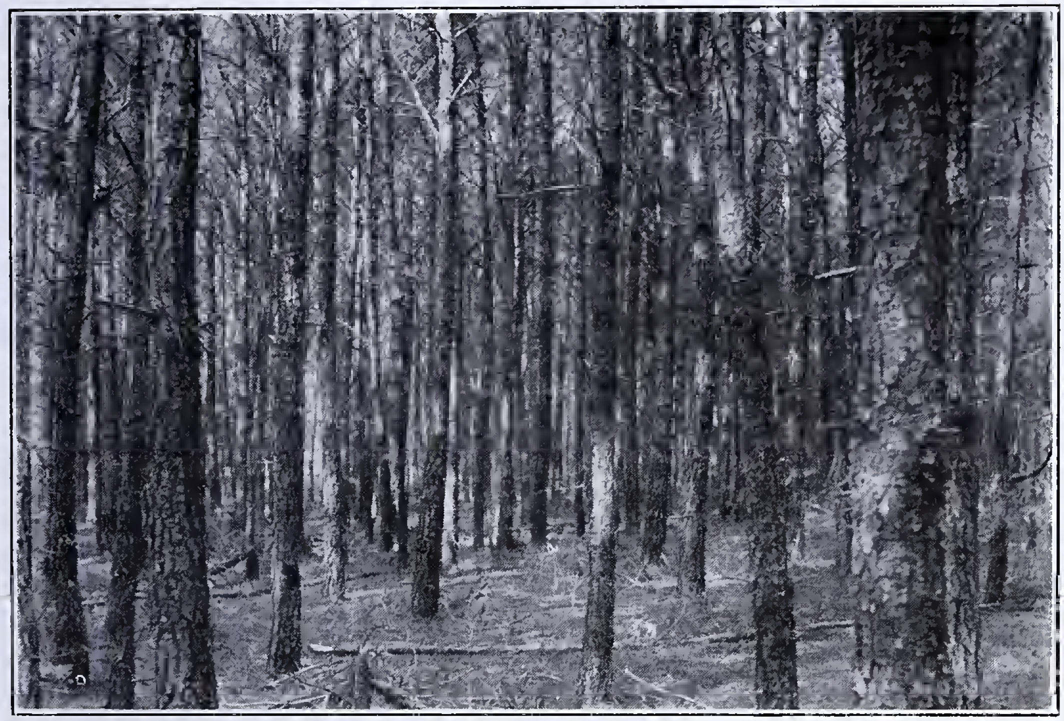

PLATE 14—TWENTY-TWO-YEAR OLD STAND OF LOBLOLLY PINE.
Overcrowding and death of trees very noticeable.

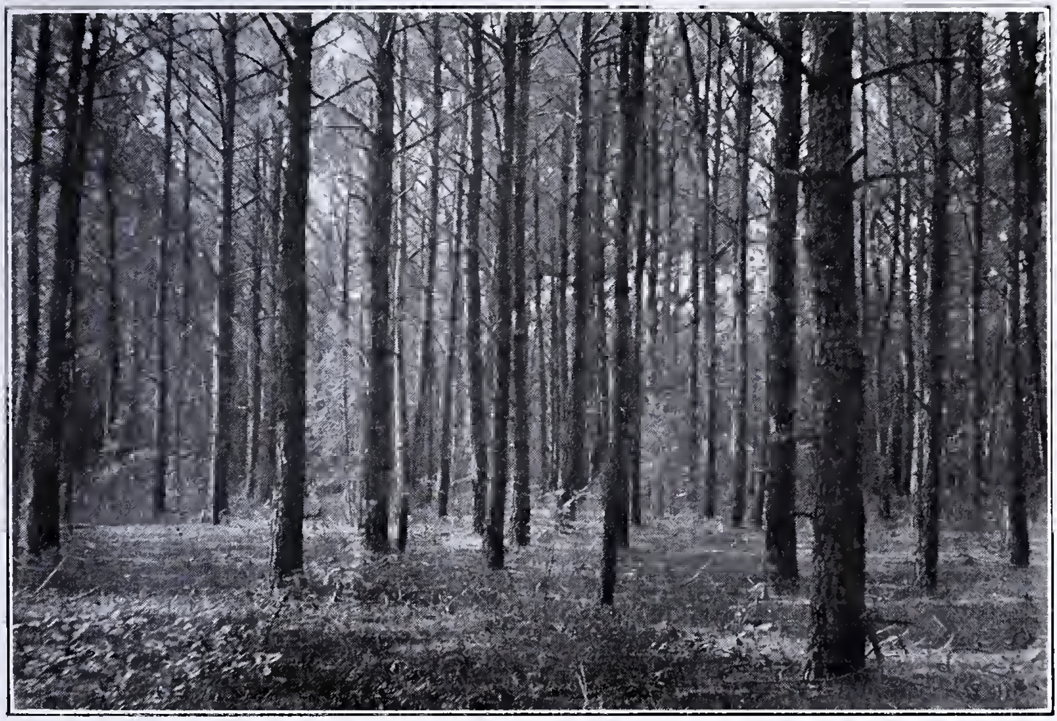

PLATE 15—SAME STAND AS IN PLATE 14 AFTER A THINNING HAD BEEN MADE.
Five cords of wood per acre were removed.

In 1920, under the direction of the State Department of Forestry, a thinning for fuelwood was made in a fifteen-year-old stand, north of Salisbury. This unusually rapid growings tand contained 1,800 trees to the acre, estimated to cut 25 cords of wood, utilizing down to 2-inch sticks. A thousand trees were taken out which, when cut and ranked as stove wood, measured 10 cords and brought the owner a net profit of one dollar a cord, or $10.00 per acre. So far as is known, no profitable thinnings have ever been made at an earlier age in Maryland.

Usually the material to be taken out in thinnings is not of sufficient size to be of value until the stand is 20 years old. By the time the stand reaches the age of 30 years the trees to be cut in thinnings are large enough to be used for barrel staves.

For example, in a 33-year-old stand in Worchester County 98 trees to the acre were removed, containing 2,762 board feet, log scale, and were sold to a nearby stave mill for a net profit of $20.40 an acre. These trees averaged 8 inches D. B. H.

In a growing stand under proper management, the owner will make thinnings at 5-year intervals, starting at 20 years, and continuing until the stand is ready to harvest at 40 to 50 years of age, or four to six thinnings in all. As a conservative estimate, each thinning during the life of the stand can be figured to bring in returns averaging at least $5.00 per acre. This sum represents an income of $.50 per acre, per year, during the life of the stand, assuming it was cut at 40 years and more than offsets the cost of protection and taxes.

The Kind of Trees to Take Out.

Natural thinning takes place by the crowding and gradual overtopping of the less vigorous trees, which succumb from lack of light and soil moisture. It is the object, therefore, in making thinnings, to take out not only those that are dead and dying, but also those, which by the appearance of the crowns and their relative position in regard to direct light, will die within the next few years, and at the same time enlarge the growing space for the crowns of those trees that are to remain.

Figure 1 is a cross-section of an actual stand in Worcester County and shows clearly the distribution of trees of varying height and how the work of natural thinning goes on. Figure 2 shows the same stand five years later, the struggle still continuing, and the trees succumbing at the rate of about 25 per acre, per year.

For convenience, the trees of various heights in the stand are designated as follows:

A—Dominant—the largest trees in the stand.
B—Co-dominant—not quite so tall as Class A.
C—Intermediate—pretty well crowded, narrow crown, receiving light only from overhead.
D—Overtopped—all direct light shut off and death only a matter of a few years.
E—Dead.

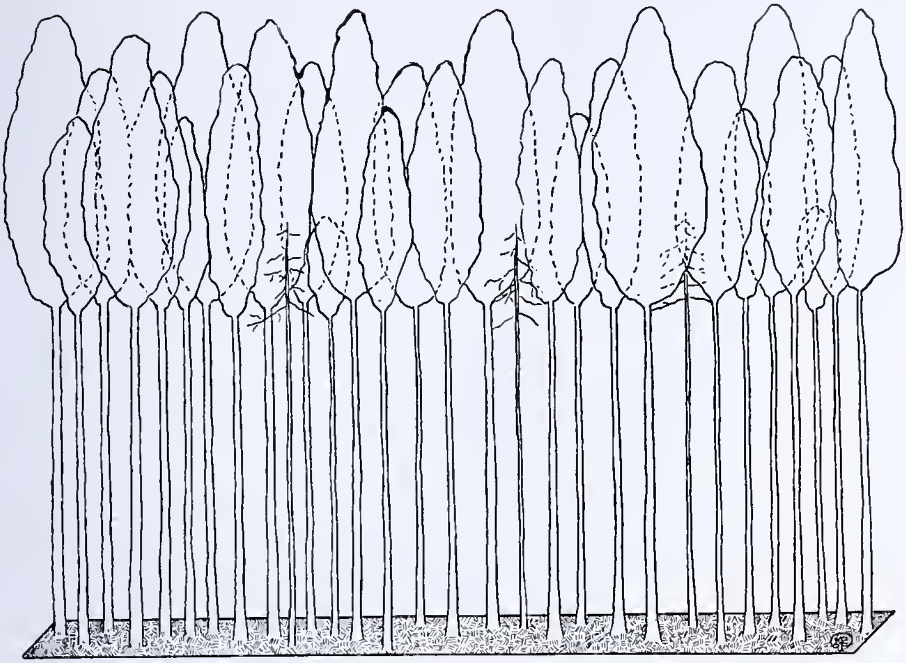

FIGURE 1—NATURAL STAND AGE 19.

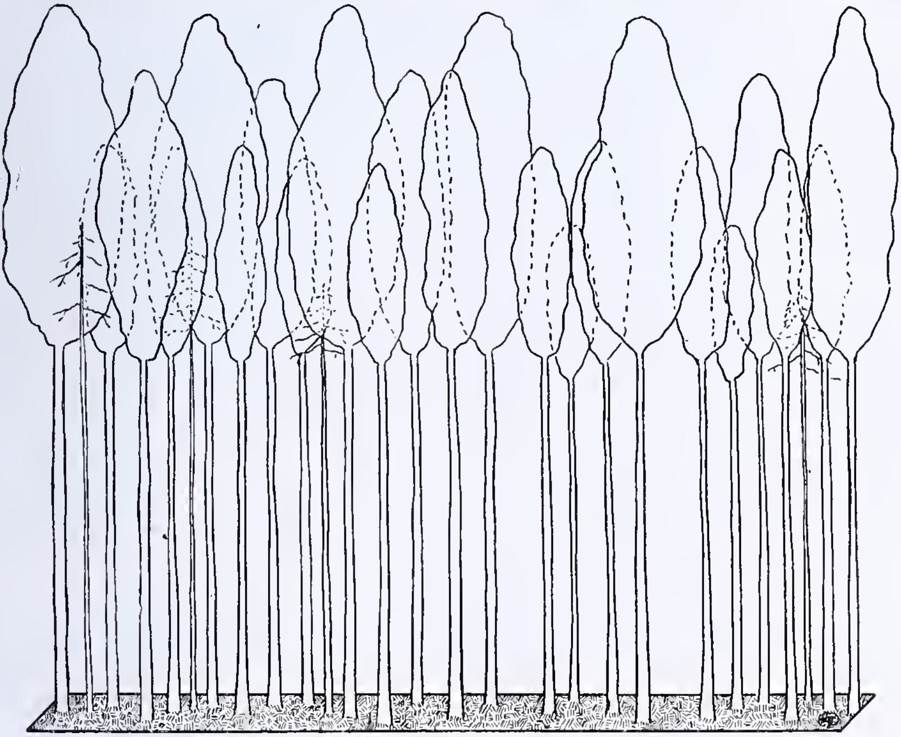

FIGURE 2—NATURAL STAND AGE 24.

The above figures are taken from the records of the permanent sample plots established in Maryland by the United States Forest Service in 1906. The area indicated is 1/40 of an acre Site Quality II. The horizontal scale is approximately 33 feet to the inch, and the vertical scale is three times the horizontal.

Number and class of trees in plots under natural conditions:

AGE	DOMINANT	CODOMINANT	INTERMEDIATE	OVERTOPPED	DEAD	TOTAL
19	9	11	5	2	3	30
24	6	5	10	2	4	27

It will be noted that the 5-year interval has brought an increasing number of trees in the intermediate class, trees that could be removed to the betterment of the stand.

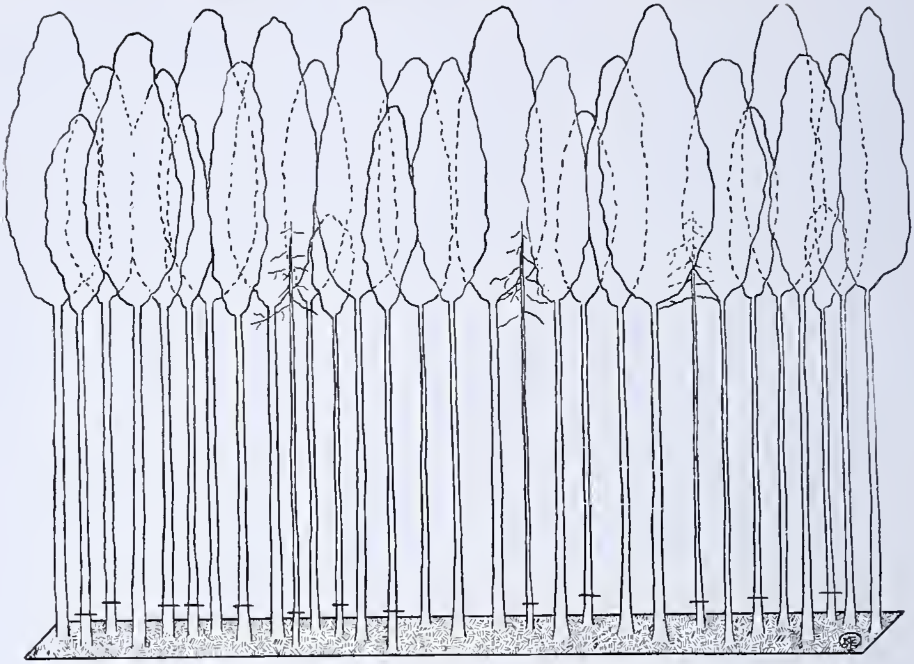

FIGURE 3—SAME STAND AS FIGURE 1, BUT TREES FOR C GRADE THINNING MARKED FOR REMOVAL.

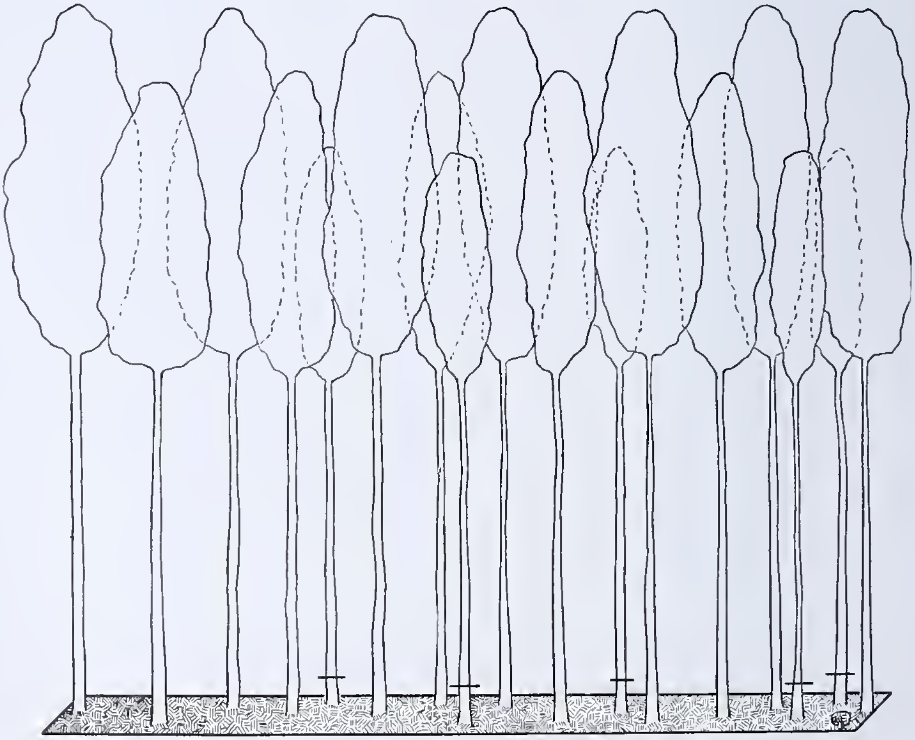

FIGURE 4—THE EFFECT OF THINNING INDICATED IN FIGURE 3, SHOWN 5 YEARS LATER. TREES MARKED FOR NEXT THINNING.

The thinnings indicated in figures 5 and 6 at age 19 and 24—removed the following trees:

AGE	CODOMINANT	INTERMEDIATE	OVERTOPPED	DEAD	TOTAL
19	3	5	2	3	13
24	--	5	--	--	5

In the managed stand there are at age 24, 480 live trees to the acre as compared with 920 trees in the natural stand.

In aiding nature the general rule would be to take out all the dead, overtopped, intermediate, and perhaps a few co-dominant trees. Figures 3 and 4 show the before and after effect of such a thinning on an actual stand. The number of co-dominants to be removed is a matter of personal judgment and should be done with considerable care. Every gap that is made in the crown cover by the removal of co-dominants lets in just that much light to the forest floor, and thus hardwoods and underbrush are encouraged. At the same time room must be given for the expanding dominants to develop unhindered for sometime to come. Perhaps a safe rule to check one's judgment in selecting the co-dominants is to leave the stand so that, on two sides at least, the crown of each tree has a free growing space for the next two to three years.

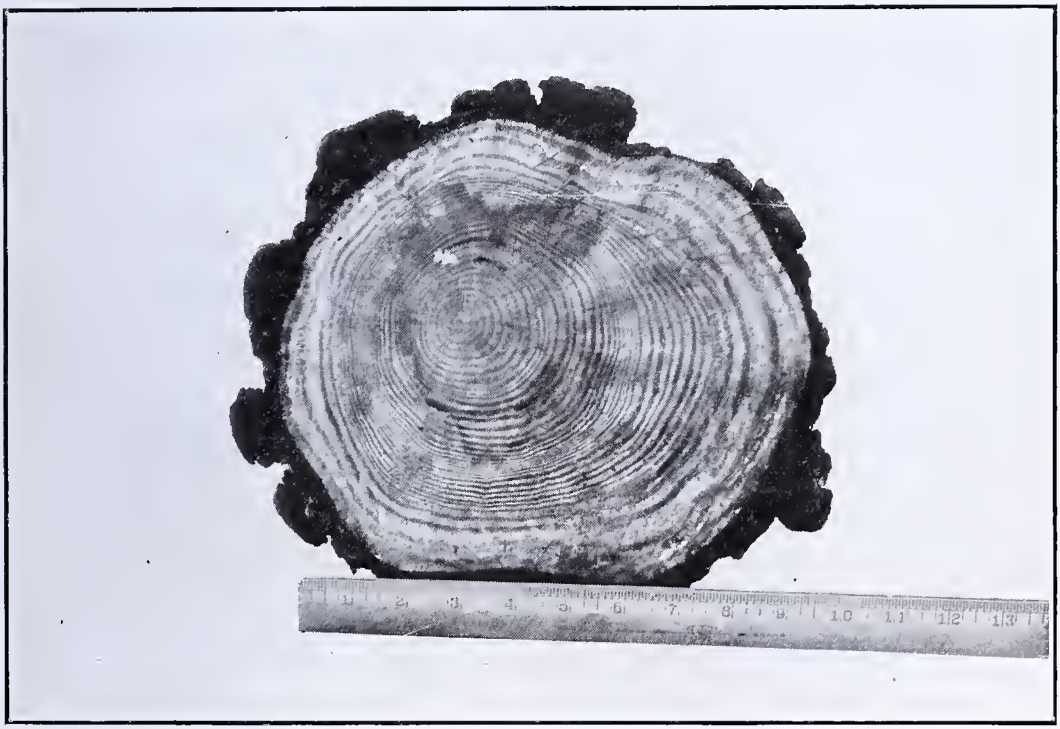

PLATE 16—STIMULATED GROWTH ON LOBLOLLY PINE AS RESULT OF HEAVY THINNING.

The accelerated growth in diameter of the trees remaining after thinnings. is shown graphically on the cross-section of a tree. Plate No. 16.

This particular tree had been left standing entirely by itself under the common methods of cutting to an 8-inch diameter limit. With practically all competition for soil moisture removed, this tree has responded with an amazingly accelerated growth.

In the thinned stand the increased growth on individual trees will not be as great, but the principle will hold true.

This is well illustrated in the following plots which were laid out side by side in a 19-year-old stand of loblolly pine. Site quality II-III. After measuring all the trees a thinning, such as has already been described, was made in one acre plot which removed 4¼ cords of wood, the other acre plot was left intact. These two plots have since been measured at five-year intervals. Though the effect of the original thinning has been somewhat lost sight of, due to the fact that no subsequent thinnings have been made, it is interesting to note that the thinned plot still shows a greater yield 15 years after, both in cubic feet and in lumber. It will be noted that heights have been fairly uniform throughout the 15 years, but average diameters are over half an inch ahead on the thinned plot. This more than makes up for the fewer trees per acre.

The number of overtopped trees in the thinned plot at age 23—five years after all such trees had been removed—indicates the practicability of successive thinnings.

TABLE 2*—Effect of thinning even aged stands of Loblolly Pine on site quality II-III.

UNTHINNED STAND.

AGE YRS	DOMINANT			INTERMEDIATE			OVERTOPPED			TOTALS		
	NO. TREES	DIAM IN.	HT. FT.	NO. TREES	DIAM IN.	HT. FT.	NO. TREES	DIAM IN.	HT FT.	NO. TREES	YIELD	
											CU. FT.	BD. FT.
18-19	1032	3.8	28	230	3.0	24	82	3.0	23	1344	1115.	---
23-24	920	4.7	37	180	3.4	28	128	3.2	27	1228	1896.	---
28-29	616	5.7	48	240	3.9	37	158	3.4	33	1014	2686.	960
33-34	468	6.7	52.5	132	5.1	44	98	4.2	35	698	3342.	3200

THINNED STAND.

AGE YRS	DOMINANT			INTERMEDIATE			OVERTOPPED			TOTALS		
	NO. TREES	DIAM IN.	HT. FT.	NO. TREES	DIAM IN.	HT FT.	NO. TREES	DIAM IN.	HT FT	NO. TREES	YIELD	
											CU. FT.	BD. FT.
18-19	972	3.7	29	204	3.0	23	94	3.0	22	1270	1054.6	---
23-24	708	4.9	38	144	3.8	29	96	3.4	25	948	1845.8	330
28-29	466	6.3	49	182	4.4	40	86	3.8	32	754	2853.6	1760
33-34	398	7.3	55	92	5.2	47	44	4.5	38	534	3606.	4962

MATERIAL REMOVED

AGE YEARS	DOMINANT	INTERMEDIATE	OVERTOPPED	TOTALS		
				NO. TREES	CU. FT.	BD. FT
18-19	154 trees	52 trees	16 trees	222	381.6 4.24 Cds.	----

*Plots established by the United States Forest Service in 1906.

THINNINGS IN MIXED EVEN AGED STANDS.

It frequently happens that young stands will contain a mixture of loblolly pine and other species. Since loblolly pine is believed to be the most valuable tree for timber production throughout the lower Eastern Shore section, it should be favored in all thinning operations over other trees, such as sweet and black gum, maple, oaks, and spruce pine. In Queen Annes, Talbot, Caroline and upper Dorchester Counties, the competition offered by spruce pine is very keen. On some of the drier sites the percentage of loblolly pine present has been found as low as 10.

In such instances, it would be unwise to remove the 90 per cent. of spruce pine merely for the sake of having a pure stand of loblolly pine. The reason for this lies in the fact that it is essential throughout the life of the stand to keep the cover complete to prevent light getting to the forest floor. The rule then would be to take out spruce pine and other species where they are offering direct competition with individual loblolly pine trees, but where their removal would cause great gaps in the crown cover they should be allowed to remain. A complete crown cover is more important than a pure stand of loblolly pine, which does not occupy all of the available growing space.

THE MATURE CROP.

As the owner watches his crop of pine developing rapidly, increasing each year both in height and diameter, the question naturally arises, when is it ready for harvesting? It has been found that the greatest growth per year in board feet is about the 50th year, in Quality I site, and somewhat later in Quality II and III sites. On the other hand it is entirely possible to grow 14-2 piling, 60-65 feet long on site Quality I in 40 to 45 years, and these same trees if left until 55 years would be too large for piling. Since piling brings a higher unit price than lumber, it would be an actual loss to the owner in gross returns to wait the extra 10 years. Again on account of the extremely close utilization, timber near to a stave mill might be most profitably harvested at age 25. In other words, the financial rotation, or the age when greatest returns on investments are received, is not always coincident with maximum annual growth. Before laying down definite rules in regard to the time of harvesting, it is advisable to give some consideration to the financial side of the proposition.

THE COST OF GROWING A CROP OF PINE.

The factors that influence total costs are: 1, Land Value; 2, Cost of Forming the Stand; 3, Taxes; 4, Administration and Fire Prevention.

There is a considerable variation in items 1 and 2, but 3 and 4 are more or less fixed. For convenience in figuring out total costs under any given set of conditions, the cost of these various items at different ages is presented in tabulated form at 4 per cent. and 6 per cent., compound interest rates. The sum of the particular variants that fit any given set of local conditions will then give the total cost of establishing and carrying the crop through to any given period.

1. Land. At the present time on the Eastern Shore, it is not possible to buy land suitable for growing loblolly pine for less than $10.00 per acre.

Closer to the markets, land has often a value of $15.00 per acre, and in some instances as high as $20.00. The highest figure that can consistently be charged for the use of land is $20.00, if any returns at prevailing rates are to be expected. It is true especially in Talbot County that pine is now growing on land valued at $40.00 to $50.00 per acre. This extra value, however, does not represent higher productivity, but the location of the land with respect to salt water, and its potential value as a home site for some wealthy investor. Since the land is still available at the end of the rotation for whatever use the owner desires, it is proper to charge only for the use of the land during the rotation.

TABLE 3—Compound interest on land valued at $10.00, $15.00 and $20.00 per acre, at 4% and 6%, for different ages.

AGE YEARS	$10.00 LAND		$15.00 LAND		$20.00 LAND	
	4%	6%	4%	6%%	4%	6%
20	$11.91	$22.07	$17.86	$33.10	$23.82	$44.14
25	16.66	32.92	24.99	49.38	33.32	65.84
30	22.43	47.43	33.65	71.14	44.86	94.86
35	29.46	66.86	44.19	100.29	59.92	133.72
40	38.01	92.86	57.00	139.29	76.02	185.72
45	48.41	127.65	72.62	191.48	96.82	255.30
50	61.06	174.20	91.60	261.30	122.12	348.40
55	76.46	236.51	114.70	354.76	152.92	473.02
60	95.20	329.88	142.79	494.82	190.39	659.76

2. Formation of the stand. When the stand is started naturally, it has been pointed out (page 9), the sale of lops, tops and trees, too small for saw logs, is ample to cover the cost of site preparation and, therefore, the only charge proper to make against the formation of the young stand is the investment in seed trees. Since these seed trees can be cut as soon as the young stand is well established and past the extreme fire danger period (first ten years), or allowed to grow to the end of another rotation, they do not represent a loss to the owner, but merely deferred payment, interest on which may or may not be offset by increased growth. At all events, it is extremely small and in such instances it is proper to consider the cost of the formation of the new stand as zero.

By using wild stock the cost will be $3.00 per acre, and if nursery grown 2 year seedlings are used, the cost will be approximately $5.00 per acre. Under abnormally difficult planting conditions and by using transplanted stock, it is possible for the cost of formation to be $10.00 per acre, and this figure is included in the tabulation for such a contingency.

TABLE 4—Compound interest on cost of formation at $3.00, $5.00 and $10.00 per acre, at 4% and 6%, for different ages.

AGE YEARS	$3.00		$5.00		$10.00	
	4%	6%	4%	6%	4%	6%
20	$6.57	$9.61	$10.95	$16.03	$21.91	$32.07
25	8.00	12.87	13.33	21.45	26.66	42.92
30	9.73	17.23	16.22	28.71	32.43	57.44
35	11.84	23.05	19.73	38.43	39.46	76.86
40	14.40	30.85	24.00	51.42	48.01	102.86
45	17.52	41.29	29.20	68.82	58.41	137.65
50	21.32	55.26	35.53	92.10	71.07	184.20
55	25.94	73.95	43.23	123.25	86.46	246.51
60	31.56	98.96	52.60	164.94	105.20	329.88

3. Taxes. Careful scrutiny of prevailing methods of taxing timberland throughout the Eastern Shore, indicates that the minimum assessed valuation placed on cut over lands is from $10.00 to $15.00 per acre. This valuation is usually raised by $5.00 amounts at intervals, as the timber grows in size and value. The maximum valuation placed on mature timber is $40.00 per acre, even in cases where it is well known that the stand can be sold at $200.00 per acre.

While this method is not sound economically, it can be readily seen that it has not tended to rush mature timber on the market. In figuring taxation costs for different periods, the value of land and timber has been placed at $10.00 for the first 10 years, and raised $5.00 by decades, making an assessed valuation of $35.00 at 60 years. An average of representative counties for the past few years shows that county and state taxes together amount to about 2 cents on the dollar and this rate has been used in the compilation.

4. Administration and Fire Prevention. An owner who has invested money in establishing a crop of pine is going to see that it is taken care of, so that the maximum yield may be obtained. An annual outlay of 2 cents an acre, per year, is sufficient for this purpose under the very favorable conditions that are prevalent throughout the range of loblolly pine in Maryland.

TABLE 5—Compound interest on administration at 2 cents per acre per year, and taxes at 2 cents on the dollar, at 4% and 6%, for different ages.

AGE YEARS	ADMINISTRATION 2 CENTS PER ACRE		TAXES* 2 CENTS		TOTAL	
	4%	6%	4%	6%	4%	6%
20	$ .59	$ .73	$7.15	$8.66	$7.74	$9.39
25	.83	1.09	10.87	13.86	11.70	14.95
30	1.12	1.58	15.39	20.79	16.51	22.37
35	1.47	2.23	21.43	30.66	22.90	32.89
40	1.70	3.00	28.79	43.84	30.49	46.93
45	2.42	4.25	38.27	62.06	40.69	66.31
50	3.04	5.81	49.82	86.43	52.86	92.24
55	3.82	7.88	64.40	125.12	68.22	133.00
60	4.75	10.66	82.15	164.04	86.90	174.70

*In figuring taxes the land is assessed at $10.00 for first decade and raised by $5.00 amounts for each succeeding decade.

In actual application then, the owner might figure that his land would cost him $15.00 for instance, and that the formation of the stand would cost $5.00 per acre. If he desired to cut at age 40 the cost would be $57.00 plus $24.00, plus $30.49 or a total of $111.49 per acre as a 4 per cent. investment. As a 6 per cent. investment the cost would be $234.55 per acre.

GROSS REVENUE AND PROFITS.

In figuring up the gross revenue that would be obtained from a stand at any given age, there are two factors to be considered, yield and stumpage values, and both are subject to considerable variation. Yield,* it will be remembered, is shown for three quality sites, dependent on the suitability of the land to grow pine. Stumpage values are dependent on distance of timber from markets and transportation.

On account of the fluctuations in stumpage values from year to year, it does not seem practical to express gross revenue in tabulated form, taking into account all the variants of site quality and distances from market. The owner sufficiently interested in growing a crop of pine will investigate the probable costs and returns from such an undertaking, and will have a fair idea of local stumpage values or can figure it out from tables.

In figuring out just what may be expected in the way of returns from a crop of pine, the owner must first determine the relative suitability of the land to grow pine. Height growth of dominant trees in a given number of years is a fair indication of this suitability, so measurements of height should be taken in nearby stands where conditions appear about equal to those of the site under consideration. These measurements would indicate whether to use site quality I, II or III tables for yield. For instance, if the dominants prove to be 65 feet high at 35 years the owner would see by referring to the yield tables that such a relation indicates site quality II. Present stumpage values current in the locality will be used even if the crop is to be harvested 40 years hence. Gross returns at any desired age are found by multiplying yields obtained in the yield table by stumpage.

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*Appendix, Page 47

For purposes of illustration this is worked out for different ages under an assumed set of conditions which may be taken as average.

Costs:
Land..................................$15.00 per acre.
Formation of stand ....5.00 per acre.
Stumpage value ....10.50 per M. Bd. Ft.
Productivity of land—Site Quality II.

TABLE 6—Profit or loss on growing crop of Loblolly Pine at different ages, under assumed conditions.

AGE YEARS	4% COMPOUND INTEREST	6% COMPOUND INTEREST
25	— $8.02	— $43.28
30	+ 14.47	— 41.37
35	+ 42.33	— 42.46
40	+ 71.30	— 51.79
45	+ 96.89	— 87.21
50	+ 109.81	— 155.84
55	+ 95.15	— 289.71
60	+ 55.86	— 496.36

As a 4 per cent. investment the owner will get a profit per acre for every five-year period except the first, and the greatest returns at the age of 50 years.

On the other hand as a 6 per cent. investment, there will be a loss at every period, the smallest loss being at ages 30 to 35, showing very plainly that higher interest rates tend to shorten the financial rotation. On site quality I at 6 per cent. compound interest, a profit of over $30.00 per acre is shown at age 35. From these facts the general conclusion can be drawn that land other than site quality I cannot show a profit at 6 per cent. compound interest at any age, unless the stand is started naturally, *i. e.*, scattered seed tree method, as long as stumpage values remain around $10.00 per thousand board feet.

Local market conditions, the rate of interest that it is desired the stand should earn, the quality of the land for producing pine and its value, all tend to make an individual problem of each stand that is approaching maturity. With the tabulation already given as a guide, no owner can go far wrong in deciding when the harvesting of a crop will bring him the greatest returns.

As a general average for the range of the species in Maryland, it is believed that a rotation of from 40 to 50 years will be satisfactory. Within these limits the condition of local markets should indicate the particular time when the timber should be put on sale, and if possible some consideration should be given to a seed year, which, it will be remembered, occurs at three- to four-year intervals.

If arrangements can be made for cutting immediately after a heavy seed year, the seed from the entire stand will be available to establish the new crop, and the leaving of seed trees is only necessary as insurance against forest fires.

Estimating Contents of the Stand.

It is most essential that the owner have some idea of the contents of the stand he is offering for sale. The total acreage should first be ascertained, then by estimating yield on fractional areas, a fair idea of total yield can be obtained.

For this purpose, circular plots ¼ of an acre in diameter will be found most convenient. These should be laid out in what seem average conditions in the stand, at least, one plot for every 10 acres of area.

A circle with a radius of 59 feet gives an area of ¼ of an acre. In the actual work of laying out such plots it will be found advantageous to pace out in four directions from an established center and mark the 59 foot point on each of these lines conspicuously by tree blaze or pieces of paper caught on the underbrush. Returning to the center it will now be found relatively easy to count all the merchantable trees within the limits of the circle, using the four marks as guides. Doubt in regard to any particular tree, as to whether it is in or outside the circle can be checked by pacing out from the center. Having ascertained the number of merchantable trees on the quarter-acre plot, these are converted to board feet or cords by means of volume tables.

Pick out what seems to be a tree of average size and height in the plot and get diameter to the nearest inch and height to the nearest 10 feet in accordance with methods fully described in detail in the Appendix, pages 37-39. Table 11 on page 41 gives the board foot contents of such a tree, and by multiplying by the total number of merchantable trees, the total yield of the plot is obtained. The sum of the yield of these plots of known area, in direct proportion to the known area of the entire stand, will give the yield of the entire stand.

The accuracy of the figures obtained depends to considerable extent on the judgment of the estimator, first in picking out average plots, and second in picking out an average tree in the plot.

With a little care and practice, the estimate obtained should not vary more than 15 per cent. from the actual contents of the stand, and this is sufficient for the object desired.

The above description gives the yield in board feet. It is equally easy to express this yield in staves, mine props, cordwood, or pulpwood by using the proper volume table. (See appendix).

STUMPAGE VALUES.

Having ascertained the quantity of standing timber and decided on its best utilization, an idea of its proper stumpage value can be obtained by consulting the tables of costs for that particular product int he Appendix of this bulletin. Prices of the product fluctuate as do also the labor costs, so the costs and values there given are only relative. They do show, however, the basis by which stumpage values are obtained and consequently, by adjustments to fit existing conditions, a fair value can be obtained in any locality. It is obviously impossible to give exact figures, since even experienced lumbermen often disagree as to estimates, costs, etc. It is believed, however, that an intelligent use of the knowledge set forth in this bulletin will enable the average woodland owner to estimate with reasonable accuracy the quantity and value of his standing timber, and so place him in a position to deal satisfactorily with a prospective buyer.

Selling the Timber.

It is advisable to advertise the timber that it is desired to sell, in order that the owner may have the advantage of competitive bidding. The following is submitted as a sample:

I am offering for sale on my farm on the........................Road, ...miles from........................County, Md.........acres of standing ....pine timber estimated to cut..................board feet, more or less. For further particulars address................................

It is advisable to have a written contract covering the terms of sale in order that both the owner and buyer may be safe guarded. Such a contract should make provisions for the following items:

1. Leaving of Seed Trees. Unless the owner is going to put the land under cultivation, seed trees provide the cheapest and most practical method of securing another stand of pine. It will be necessary for the owner to mark the seed trees prior to cutting operations, preferably with white paint, using some such method as is described on page 6 to insure their proper distribution. It may be necessary to take some reduction in total stumpage value in order to save these seed trees, but that is an excellent investment. Heavy penalty should be provided in the contract for the cutting of such seed trees.

2. Manner of Payment. As evidence of good faith, the owner should require a substantial part of the contract price to be turned over before any timber is cut, and subsequent payments should always be in advance of cutting, so that the termination of the contract at any time will not leave the owner at a disadvantage.

3. Limitation of Time for Removal of Timber. In the past, the practice has been to give too long a time for the operator to remove the timber. Delays of several years in turning the land back to the owner simply increase the cost of preparing the seed-bed conditions for the next crop. In tracts up to 100 acres in extent, three years should be the maximum time allowed. On larger areas, provision should be made that definite proportions be turned back at stated intervals, so that the owner may at once start preparations for the next crop.

There is on record one instance where an owner had seed trees marked on 125 acres of fine loblolly pine, but allowed the buyer 10 years in which to remove the timber. At the expiration of this long period the brush and hardwood sprouts will, so completely, have dominated the area as to make reseeding difficult and expensive even with the seed trees present.

A sample contract covering the main provisions as outlined will be found in the appendix.

APPENDIX.

VOLUME TABLES.

It frequently happens that an owner desires to know just how much of a given product, such as piling, mine props, staves, pulpwood or lumber can be obtained from his standing trees.

These quantities have been worked out for trees of different diameters and heights in what are properly termed volume tables. In actual use, then, it only becomes necessary to obtain the diameter of the tree outside the bark at the breast high point (4½ feet from the ground) to the nearest inch and estimate total height to the nearest 10 feet and look up the result where these two columns intersect in any table that is desired.

MEASURING DIAMETER.

The diameter is taken 4½ feet from the ground rather than at the stump, for two reasons: First, it is a much easier place to measure as it can be done without bending over, and secondly, it is well above the root swelling and consequent irregularities of diameter. Except in very small trees it is not sufficiently accurate to guess diameters, at least until considerable practice has been had. There are two simple methods of obtaining diameter.

1. Measure the circumference of the tree to the nearest inch and look up the corresponding diameter in the following table:

TABLE 7—Relation between circumference and diameter in inches.

Circumference Inches	Diameter Inches
18.8	6
22.0	7
25.1	8
28.3	9
31.4	10
34.5	11
37.7	12
40.8	13
44.0	14
47.1	15
50.3	16
53.4	17
56.5	18
59.7	19
62.8	20

2. Take an ordinary yard stick and grasping it with thumb and finger of the right hand, hold it parallel with the ground against the tree at the breast high point. In doing this your eye should be about 25 inches from the tree which means practically arms length for the average man. It is an easy matter to check this distance by actually measuring to see just how far away from your eye you have to hold the yard stick to cover the 25 inches. Now slide the stick along until the left end is just flush with the bark on the left side of the tree as it appears from where you stand, and note the nearest inch intercepted on the right-hand side by the outer bark of the tree in your line of vision. Look this value up in the table given below and you will have diameter of the tree to the nearest inch:

TABLE 8—Relation between reading on yard stick and actual diameter.

COLUMN "A" Inches Read on Yard Stick When Held Against Tree at Distance of 25 Inches from the Eye.	COLUMN "B" Actual Diameter of Trees of Apparent Diameters Given in Column "A."
5½	6 inch diameter tree
6	7 inch diameter tree
7	8 inch diameter tree
7¾	9 inch diameter tree
8½	10 inch diameter tree
9¼	11 inch diameter tree
9¾	12 inch diameter tree
10½	13 inch diameter tree
11¼	14 inch diameter tree
11¾	15 inch diameter tree
12½	16 inch diameter tree
13	17 inch diameter tree
13¾	18 inch diameter tree
14¼	19 inch diameter tree
15	20 inch diameter tree

OBTAINING HEIGHT OF STANDING TREES.

Where a fallen tree cannot be found to give approximate height, it is necessary to measure standing trees.

The simplest method of arriving fairly accurately at the total height of a tree is by an application of the principle of similar triangles. Select a straight stick about 4 feet long (if weighted at the lower end it is still better), and hold this perpendicularly at arms length, between thumb and forefinger at such a point (determined by measuring) that the length of stick above the point grasped will just equal the distance from the eye to the stick. Walk carefully backward or forward until a point is reached where, when the stick is held at arm's length, the line of sight passes just over the top of the stick to the top of the tree and over the finger and thumb to the base of the tree. If the stick is perpendicular (hence the advantage of the weighted end), the distance from the eye to the tree will just equal the height of the tree. This distance is then readily taped or stepped off.

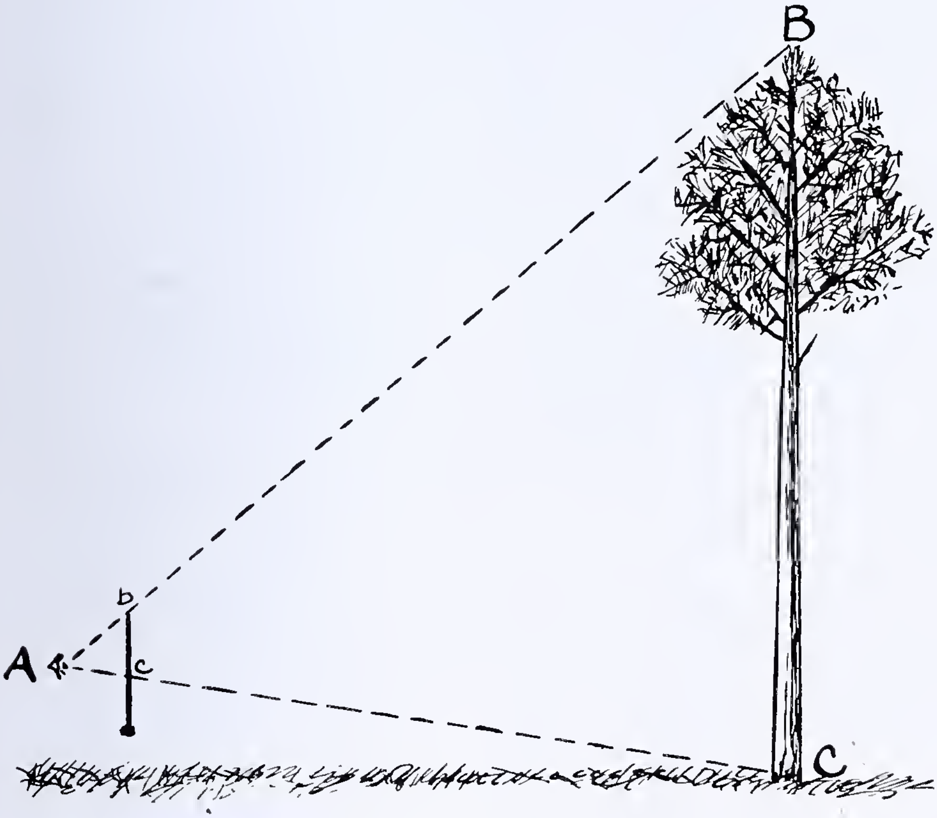

FIGURE 5—DETERMINING HEIGHT OF STANDING TREES.

LOG RULES.

The board foot contents of trees of different diameters and heights is obtained by dividing the tree into logs and scaling the top diameters inside the bark of all logs 6 inches and over in diameter. The proper rule to use, in order to give results approximating what would actually be sawed out, was a matter requiring a definite ruling.

The Doyle rule has been in common use among lumbermen in Maryland for years—but the figures it gives for small logs, in which classification most of the timber now cut would come, are so manifestly unfair to the seller, that the Forestry Department rejected it from the very beginning in working up volume tables.

After repeated tests in both hardwoods and pine the Maine Rule was officially adopted by the Department, because the results obtained were so close to the actual mill scale at portable mills throughout the State. (See Table 10.)

TABLE 9—MAINE RULE (values made regular by interpolation.)

Dia. Inside Bark Small End, Inches	Length in Feet				
	8	10	12	14	16
	Board Foot Contents				
5	7	8	9	10	12
6	11	13	15	17	20
7	15	19	23	26	30
8	21	26	31	36	42
9	27	34	41	47	54
10	35	43	51	59	68
11	42	52	62	73	83
12	50	62	75	87	99
13	58	73	88	102	117
14	68	85	102	119	136
15	79	98	118	137	157
16	90	112	135	157	180
17	103	128	154	179	205
18	116	145	175	204	233

RULE OF THUMB.

In some sections of the Eastern Shore it has been customary to secure the board feet contents of a 12 foot log by multiplying the diameter at the small end inside the bark by ½ the diameter. In case of logs of longer or shorter length, fractional values are added or substracted as the case may be. This gives accurate results as shown in the comparative tables and it has the further advantage of being so quickly obtained.

TABLE 10—Board foot values for logs of different diameters and 12 feet long.
BOARD FOOT CONTENTS.

DIAMETER SMALL END INSIDE BARK, INCHES	MILL SCALE BOX SHOOK LUMBER INCH BOARDS	RULE OF THUMB D×½D	MAINE RULE	DOYLE RULE
4	7	8	5	--
5	10	12	9	--
6	17	18	15	3
7	22	24	23	7
8	30	32	31	12
9	40	41	41	19
10	50	50	51	27
11	61	60	62	37
12	74	71	75	48
13	85	83	88	61
14	103	97	102	75
15	117	112	118	91

Based on 100 logs—portable mill—¼ inch kerf.

It is at once evident from these figures that either the Maine Rule or the Rule of Thumb give results surprisingly close to the actual mill tally, and further, that in justice to the seller of pine timber the Doyle Rule should never be used.

TABLE 11—BOARD FOOT VOLUME obtainable from trees of different height and diameter.

DIAMETER BREAST-HIGH INCHES	HEIGHT IN FEET					
	40	50	60	70	80	90
	BOARD FEET VOLUMES					
8	10	15	20	25	30	--
9	--	30	35	45	55	--
10	--	50	60	70	80	--
11	--	65	75	90	110	--
12	--	80	100	120	140	160
13	--	100	120	145	170	195
14	--	120	140	170	200	230
15	--	135	165	200	235	270
16	--	---	190	230	270	310
17	--	---	210	255	300	345
18	--	---	235	280	330	380
19	--	---	---	310	365	415
20	--	---	---	340	400	455
21	--	---	---	---	440	500
22	--	---	---	---	480	545

Maine Rule to 6 inch top.

TABLE 12—Diameter and height of trees required to give different size and length of PILING.

INCHES, D .B. H.	HEIGHT, FEET					
	50	60	70	80	90	100
	LENGTH AND SIZE OF PILING					
12	12–0–30†	12–0–40	-------	-------	-------	-------
13	12–0–35	-------	12–2–50	-------	-------	-------
	-------	12–2–40	-------	-------	-------	-------
14	-------	-------	12–2–50	12–2–55	-------	-------
	-------	-------	-------	12–2–60	-------	-------
	-------	12–2–40	-------	-------	-------	-------
	-------	12–2–45	-------	-------	-------	-------
15	-------	12–2–45	-------	-------	-------	-------
	-------	-------	-------	14–2–55	-------	-------
16	-------	-------	14–2–50	14–0–60	-------	14–2–75
	-------	-------	14–4–50	14–2–60	-------	14–2–80
	-------	-------	-------	14–4–55*	14–2–65	-------
	-------	-------	-------	-------	14–2–70	-------
17	-------	-------	14–4–50*	14–4–60*	14–2–70	14–2–75
	-------	-------	-------	-------	14–2–75	14–2–80
	-------	-------	-------	-------	14–4–70*	14–4–75*
18	-------	-------	-------	-------	14–4–75*	14–4–75*
19	-------	-------	-------	-------	-------	14–4–80*

*Seven inch top, otherwise six inch top.

†First number describes diameter, second point of measurement from butt; the third refers to its length in feet.

TABLE 13—MINE PROPS obtainable from trees of different height and diameter.

D. B. H. INCHES	HEIGHT IN FEET				
	50	60	70	80	90
	CLASS OF PROP				
9	----	----	A1	A1	----
10	A1	A1	A1	A1	----
11	A1	A1	A1	A1-A1	----
12	A1	A1	A1-A1	A1-A1	A1-A1
13	A1	A1-A2	A1-A1	A1-A1	A1-A1
14	A1	A1-A2	A1-A1	A1-A1	B1-A1
15	B1	B1-A2	B1-A1	B1-A1	B1-A1
16	----	B1-A2	B1-A1	B1-A1	B1-A1-A2
17	----	B1-A2	B1-A1	B1-B1	B1-B1-A2
18	----	B1-A2	B1-A1	B1-B1	B1-B1-A2
19	----	----	B1-A1	----	B1-B1-A2

A1 equals small prop 27 feet long; B1 equals large prop 27 feet long.
A2 equals small prop 18 feet long; B2 equals large prop 18 feet long.

TABLE 14—Total weight in pounds of MINE PROPS for trees of different height and diameter.

D. B. H. Inches	HEIGHT IN FEET				
	50	60	70	80	90
	Number of Pounds*				
9	---	---	490	480	---
10	490	490	690	690	---
11	690	690	860	1,310	---
12	860	860	1,310	1,430	1,590
13	1,020	1,400	1,590	1,710	1,900
14	1,210	1,590	1,780	1,710	2,240
15	1,210	1,870	2,100	2,240	2,240
16	---	2,040	2,270	2,410	2,860
17	---	2,140	2,700	2,850	3,400
18	---	2,430	2,700	3,350	3,730
19	---	---	3,180	3,710	4,270

*Weight rounded to nearest 10 pounds.

TABLE 15—CORDWOOD obtainable from trees of different height and diameter. 4 foot lengths, with bark, to 3 inch top.

D. B. H. Inches	Height in Feet					
	20	30	40	50	60	70
	Contents in Cubic Feet					
3	.268	.268	.252	----	----	----
4	.712	.932	1.140	----	----	----
5	1.312	1.940	2.276	2.972	----	----
6	----	2.852	3.552	4.420	5.612	----
7	----	4.140	4.996	6.104	7.324	8.656
8	----	5.392	6.552	7.956	9.512	11.044
9	----	----	----	10.272	12.224	14.092
10	----	----	----	13.016	15.020	17.420
11	----	----	----	15.936	18.264	21.072
12	----	----	----	18.688	21.576	24.624
13	----	----	----	21.640	25.300	29.052
14	----	----	----	24.940	29.108	33.740
15	----	----	----	28.252	33.276	38.788
16	----	----	----	----	38.212	43.948
17	----	----	----	----	42.570	48.944
18	----	----	----	----	47.156	54.244
19	----	----	----	----	----	59.736
20	----	----	----	----	----	65.352

In converting these cubic feet figures to cords the figure of 90 cubic feet should be used.

N. B.—There is of course wide variation in the amount of solid wood in a stacked cord, depending on size of stick, whether round or split, whether straight or crooked, and whether knots are well trimmed or not. Actual measurements of ranked cords showed an average content from 75-80 cubic feet for tops and lops. Solid stem wood gave an average content of 90 cubic feet.

TABLE 16—BARREL STAVES obtainable from trees of different height and diameter.

D. B. H. Inches	Height in Feet						
	30	40	50	60	70	80	90
	Number of Staves						
5	--	--	28	--	---	---	---
6	28	28	56	84	---	---	---
7	45	73	73	118	146	---	---
8	83	108	136	153	199	244	---
9	--	---	173	190	236	300	---
10	--	---	190	227	295	360	---
11	--	---	232	278	363	426	---
12	--	---	280	345	409	495	574
13	--	---	333	406	492	555	657

TABLE 17—PEELED PULPWOOD obtainable from trees of different height and diameter 5 feet lengths to 3 inch top.

D. B. H. Inches	Height in Feet							
	20	30	40	50	60	70	80	90
	Cubic Feet							
4	0.375	0.355	.335	-----	-----	-----	-----	-----
5	0.965	1.245	1.520	1.895	-----	-----	-----	-----
6	-----	2.245	2.590	3.415	4.310	-----	-----	-----
7	-----	3.080	3.865	4.715	5.735	6.630	-----	-----
8	-----	4.005	5.270	6.365	7.510	8.715	10.655	-----
9	-----	-----	-----	8.145	9.805	10.995	13.305	-----
10	-----	-----	-----	10.355	12.180	13.855	16.380	-----
11	-----	-----	-----	12.675	14.925	17.100	19.765	-----
12	-----	-----	-----	14.835	17.740	20.435	23.565	26.325
13	-----	-----	-----	17.750	20.725	23.890	27.550	30.240
14	-----	-----	-----	20.670	24.075	27.975	32.015	35.320
15	-----	-----	-----	23.685	27.775	32.425	37.035	40.570

In converting these cubic feet figures to long cords, the figure of 120 cubic feet should be used.

BASIS OF VOLUME TABLES.

All the volume tables here given were obtained from taper curves constructed in the office from taper measurement taken on 500 trees ranging in diameter from 2 to 25 inches and in height from 30 to 100 feet.

CONVERTING TABLES.

It is frequently advantageous for the owner to compare the stumpage value he would receive for his timber in different products. This is possible through the converting factors already worked out in the case of each important product.

For convenience they are again tabulated here. In every case the basic unit is the board foot or thousand board feet since this is a universally recognized standard.

Mine props..............................1 ton = 200 Bd. Ft.
Barrel Staves......................3800 staves = 1000 Bd. Ft.
Keg staves (18 in.)................7000 staves = 1000 Bd. Ft.
Piling, 12-2-50.........................1 piling = 170 Bd. Ft.
14-2-70.........................1 piling = 310 Bd. Ft.
Pulpwood, 1½ long cords (peeled)............ = 1000 Bd. Ft.
Fuel wood..................2 cords split wood = 1000 Bd. Ft.

Applying these figures to the stumpage values given to the various products the following table is derived:

TABLE 18—STUMPAGE VALUE OF DIFFERENT PRODUCTS BASED ON ONE THOUSAND BOARD FEET.

(Wagon Haul Only)

DISTANCE FROM MARKET MILES	BOX SHOOK LUMBER AT $26.00	MINE PROPS		PILING		
		SMALL AT $3.50 PER TON	LARGE AT $4.60 PER TON	12-2S AT $ .09 PER LINEAL FT.	14-2S AT $ .13 PER LINEAL FT.	
5..............	12.25	4.00	9.50	13.30	13.36	-----
3..............	13.50	7.45	12.95	16.50	16.70	9.04
2..............	14.00	9.20	14.70	18.00	18.40	9.25
1 and under....	15.00	10.25	15.75	19.00	19.40	9.60

This table serves to emphasize further the greater value obtained from piling than any other utilization, and owners should avail themselves of this knowledge where their timber is reasonably close to the railroad and there is active market for piling. In short hauls it will be noted also that props are more profitable than lumber.

Pulpwood and fuelwood at present prices cannot compete with other products as a major utilization for crop to be harvested, therefore, they do not figure in the above comparisons.

STUMPAGE VALUE.

It is of paramount interest to the owner to know the value of his timber as it stands, or its stumpage value. This is found by deducting from the current market price at the local factory, or shipping point, the actual costs of manufacture, shown in Table 10.

The market price fluctuates in obedience to the laws of supply and demand, but it can easily be obtained by the owner at the time he wishes to dispose of his timber. For purposes of illustration, we will assume the price current in the summer of 1923 of $26.00 per thousand for box shook lumber, delivered at the factory and $24.00 delivered at the railroad, for mine plank.

TABLE 19—Stumpage values of standing Loblolly Pine at various distances from the market based on a value of $26.00 and $24.00 for box shook lumber and mine plank.

DISTANCE MILES	BOX SHOOK LUMBER STUMPAGE	MINE PLANK STUMPAGE
8-10	$11.31	$ 9.31
5- 8	12.25	10.25
2- 5	13.50	11.50
Under 2	15.56	12.56

TABLE 20—Relation of weight to diameter of Loblolly Pine mine props for different diameters based on logs 27 feet long.

MIDDLE DIAMETER OUTSIDE BARK INCHES	BUTT LOGS, WEIGHT PER LINEAL FOOT POUNDS	TOP LOGS, WEIGHT PER LINEAL FOOT POUNDS
4	4.8	5.8
5	7.7	9.3
6	10.8	12.7
7	14.6	16.6
8	18.0	20.8
9	25.4	25.3
10	31 4	30.3
11	37.5	35.7
12	44.2	42.0
13	51.5	48.7
14	58.0	55.6
15	68.5	63.9
16	80.4	73.1
17	93.8	---
18	109.0	---

TABLE 21—Yield table for fully-stocked second-growth stands of Loblolly Pine in Maryland.

Age Years	Trees per acre No.	Av. D.B.H. inches	Av. Ht. Dom. Ft.	Total Basal Area Sq. Ft.	Yield	
					Bd. Ft. Maine Rule	Cubic Ft. with bark
QUALITY I—GOOD LAND						
15	870	5.4	38	138	-----	2,215
20	665	6.5	49	154	3,400	3,120
25	505	7.7	58	165	7.500	3,950
30	370	9.2	67	172	12,900	4,725
35	295	10.5	74	177	19.500	5,510
40	245	11.8	82	182	26,700	6,275
45	210	12.9	88	189	33,800	7,020
50	185	13.9	94	194	39,100	7,610
55	170	14.7	97	199	42,500	8,025
60	160	15.3	100	204	44,300	8,250
QUALITY II—MEDIUM LAND						
15	1,130	4.3	32	114	----	1,560
20	840	5.3	41	130	900	2,455
25	650	6.4	50	142	4,000	3,210
30	500	7.4	57	150	7,700	3,875
35	405	8.4	64	156	12,300	4,500
40	350	9.2	71	161	17,700	5,150
45	310	9.9	77	165	22,800	5,700
50	280	10.6	81	170	27,600	6,255
55	260	11.1	85	175	30,600	6,620
60	250	11.5	88	179	32,200	6,810
QUALITY III—POOR LAND						
15	1,560	3.2	27	88	------	900
20	1,035	4.4	35	111	------	1,725
25	775	5.5	42	127	1,500	2,430
30	610	6.4	49	138	4,300	3,020
35	500	7.2	55	141	7,800	3,590
40	440	7.8	61	146	11,400	4,010
45	395	8.3	66	149	15,000	4,575
50	365	8.8	70	153	18,400	4,915
55	335	9.2	73	158	21,000	5,175
60	320	9.6	76	162	23,000	5,225

Based on 157 plots on the Eastern Shore of Maryland, 58 of which are sample plots and the remainder were permanent plots established by the United States Forest Service and measured at five year intervals. Board foot yield is based on trees eight inches in D. B. H. and over—Maine rule. See page 89 for detailed discussion of this rule. Cubic foot yield is based on stemwood with bark on trees three inches and over in D. B. H., and to a three inch top.

TABLE 22—Stumpage values for standing Loblolly Pine timber at varying distances from the railroad over good, average and poor roads, assuming a price of $4.60 for large props and $3.50 for small props per ton.

Miles from Railroad	Good Roads		Average Roads		Poor Roads	
	Small Prop	Large Prop	Small Prop	Large Prop	Small Prop	Large Prop
	Price, Per Ton		Price, Per Ton		Price, Per Ton	
5-3	$1.31	$2.41	$ .80	$1.90	----	$ .85
3-2	1.84	2.94	1.49	2.59	$ .81	1.91
2-1	2.08	3.18	1.84	2.94	1.31	2.41
Under 1	2.25	3.35	2.05	3.15	1.61	2.71

TIMBER CONTRACT.

FOR CUTTING MATURE LOBLOLLY PINE, LEAVING SEED TREES

This agreement made this........................day of........................in the year of our Lord, one thousand and nine hundred and............ (A.D........................) between........................of................................ in the County of........................and State of Maryland, hereinafter called the Owner, party of the first part, and................................of ....State of................................hereinafter called the Contractor, party of the second part.

Whereas the said Owner is the owner of a tract of land situated in................................, in the County of........................and State of Maryland;

Whereon timber is standing or lying and said owner desires to utilize said timber and improve said land from a forestry standpoint, and for these purposes is about to enter into a contract with said Contractor;

Now, therefore, this agreement witnesseth:

That the said Owner for and in consideration of the sum of ....dollars to be paid as hereinafter provided, agrees:

First—To allow the Contractor to enter upon the above described tract for the purpose of cutting and removing therefrom such timber as is included in the terms of this contract.

Second—To allow the said Contractor to set up one or more sawmills at such places as shall be agreed upon by the parties of the first and second parts and clear sufficent space for this purpose.

Third—To allow the said Contractor the slabwood and tops, unless especially reserved.

The said Contractor agrees:

First—Not to cut any marked seed trees. By marked seed trees are understood only such as are daubed conspicuously with white paint near the base, and at a point on the trunk 4-5 feet from the ground.

Second—To avoid unnecessary injury to trees which are not permitted to be cut, when felling, working up the trees or hauling out any or all timber or wood—by being careful to throw each tree so that it will not fall against, into, or upon trees which are not permitted to be cut. To use existing roads, as far as practicable, only locating roads through young growth when necessary, and in no case to haul across, trample, or fell trees on growing crops except by the written consent of the owner.

Third—To refrain from cutting all trees not permitted to be cut and to pay for each tree that is so cut or wantonly injured in violation of the terms of this contract $10.00 in cash.

Fourth—To leave all present woods roads clear of tree tops, logs, brush, and other obstructions.

Fifth—To leave all streams or ditches free at all times from tops, logs, brush, and other obstructions.

Sixth—To exercise reasonable precaution against the spread of fire in the woods, to put his entire force working at the mills or in the woods, to fighting fires that may occur from any cause whatsoever.

Seventh—To complete operations under this contract on or before..

Eighth—To make the following payments to the owner or his agent, duly authorized in writing to receive the same.

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It is mutually agreed: That in case of dispute between the parties of the first and second parts in reference to matters relating to the faithful performance of the provisions of this contract such matters shall be referred to arbitrators, one of whom shall be selected by the parties of the first part and the other of whom shall be selected by the parties of the second part, and in case the two selected shall disagree, they shall select a third arbitrator; and the decision of the majority shall be final with respect either to acts to be done or compensation to be paid by either party to the other.

Witness the hands and seals of the parties to this agreement the day and year first above written.

Witness

(Signed) (Signed) (Seal)

(Signed) (Signed) (Seal)

AGRICULTURAL EXTENSION BULLETINS

The following bulletins, published by the University of Maryland Extension Service co-operating with the United States Department of Agriculture, will be mailed free of charge to any address upon request.

No. 2—Relation of Lime to Agriculture.
No. 3—The Garden.
No. 9—Electricity on the Farm.
No. 10—Improving the School Grounds.
No. 13—Why We Can Food.
No. 14—The Seventeen-Year Locust.
No. 15—Milk Cost Survey, August, 1918.
No. 17—Boys' Corn Club Lessons.
No. 18—Maryland Invites You.
No. 19—Boys' Potato Club Lessons.
No. 21—Sewing Club Lessons.
No. 23—Garden Flowers.
No. 24—Making Pigs Pay.
No. 25—The Brood Sow and Her Litter.
No. 26—Cooperative Association Law of Maryland.
No. 28—Maryland Farm Statistics (1923).
No. 30—The Marketing of Wheat in Maryland.
No. 32—Maryland Farm Statistics (1924).
No. 33—Cutting Production Costs with Farm Machinery.
No. 36—Lambs and Wool for Market.
No. 37—Winter Fattening of Steers.
No. 38—More Tomatoes from Fewer Acres.
No. 39—The House Dress.
No. 40—More Tomatoes from Fewer Acres.

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